DUPLICATE.

MONTANA AGRICULTURAL COLLEGE
EXPERIMENT STATION
F. B. LINFIELD, Director

Bulletin No. 96

IMPERIAL BUREAU
17 NOV. 1926

# A Contribution to Our Knowledge of Apple Scab

BUR.
1915
ENTOM.

BY
H. E. MORRIS
*Assistant Botanist and Bacteriologist*

BOZEMAN, MONTANA
February, 1914

# MONTANA AGRICULTURAL COLLEGE EXPERIMENT STATION

BOZEMAN, MONTANA

## STATE BOARD OF EDUCATION

| | | |
|---|---|---|
| SAMUEL V. STEWART, *Governor* | *Ex-Officio* | Helena |
| D. M. KELLY, *Attorney General* | | |
| H. A. DAVEE, *Sup't Public Instruction* | | |
| S. D. LARGENT | | Great Falls |
| C. H. HALL | | Missoula |
| WARD H. NYE | | Billings |
| W. S. HARTMAN | | Bozeman |
| O. W. MCCONNELL | | Helena |
| JOHN DIETRICH | | Helena |
| JOSEPH C. SMITH | | Dillon |
| J. BRUCE KREMER | | Butte |

## EXECUTIVE BOARD

| | |
|---|---|
| JAMES M. HAMILTON, *President* | Bozeman |
| J. H. BAKER, *Vice-President* | Bozeman |
| W. S. DAVIDSON | Bozeman |
| GEO. COX, *Treasurer* | Bozeman |
| GEO. R. CALLAWAY, *Secretary* | Bozeman |

## STATION STAFF

F. B. LINFIELD, B. S. A., *Director.*
R. A. COOLEY, B. Sc., *Entomologist.*
ALFRED ATKINSON, M. S., *Agronomist.*
P. N. FLINT, M. S., *Animal Husbandman.*
EDMUND BURKE, B. S., *Chemist.*
DEANE B. SWINGLE, M. S., *Botanist and Bacteriologist.*
O. B. WHIPPLE, B. S., *Horticulturist.*
HOWARD WELCH, D. V. M., *Veterinarian.*
J. B. NELSON, *Superintendent Dry Farm Work.*
REUBEN M. PINCKNEY, B. S., A. M., *Assist. Chemist.*
L. F. GIESEKER, B. S., *Assist. Agronomist.**
WM. F. SCHOPPE, B. S., *Poultryman.*
H. E. MORRIS, B. S., *Assist. Botanist and Bacteriologist.*
J. R. PARKER, B. Sc., *Assist. Entomologist.*
LYMAN G. SCHERMERHORN, B. S., *Assist. Horticulturist.*
R. F. MILLER, M. S. A., *Assist. Animal Husbandman.*
H. B. BONEBRIGHT, B. S. A., *Assist. Agricultural Engineer.*
G. E. SMITH, *Assistant Chemist**
E. L. CURRIER, B. Sc., *Asst. Farm Management*
B. W. WHITLOCK, B. S., *Superintendent Grain Laboratory*
M. L. WILSON, B. S. A., *County Agriculturist*
CARL H. PETERSON, *County Agriculturist*

* Absent on leave.

NOTICE—The Bulletins of the Experiment Station will be mailed free to any citizen of Montana on request. Please state whether all the publications are desired as issued or only those specified. Give name and address plainly. All communications to the Experiment Station should be addressed to

THE MONTANA EXPERIMENT STATION,
Bozeman, Montana.

MONTANA EXPERIMENT STATION

APPLE SCAB

EVA CLINE
'13

# A Contribution to Our Knowledge of Apple Scab

Apple scab has been recognized as a serious disease for many years, and a great deal of work has been done concerning the life-history of the fungus and methods of control. An idea of its importance may be gained when one considers the large amount of literature bearing on the subject, contributed from practically all portions of the civilized world where the apple is grown. Notwithstanding this, however, new facts are contributed now and then, which have a vital bearing on the subject; and with this in view the following observations are recorded.

## HISTORY OF APPLE SCAB IN MONTANA

The introduction of the disease in this State is comparatively recent, and many orchardists can recall its first appearance and have watched with much concern its rapid spread.

The disease appeared first on the east side of Flathead Lake about 1900 and spread slowly until about 1907, when scab was reported from nearly all the country surrounding the lake and also throughout the valley extending to Kalispell and Columbia Falls. It was not, however, until the year 1908 that it caused a great amount of damage and the people began to realize that they must control the scab in order to produce marketable fruit.

In the vicinity of Thompson the disease appeared about 1904, doubtless as an introduction independent of that on Flathead Lake, and gradually spread until practically every orchard in that section is infected. At Plains it was first noticed in 1907, probably carried eastward from Thompson, and at present it is found in abundance throughout that section.

In Missoula county the first record of the presence of scab was in 1908, when it was discovered in Missoula and in several orchards near Bonner. However, judging from the severity of the infection around Bonner, it must have been present there for a year or

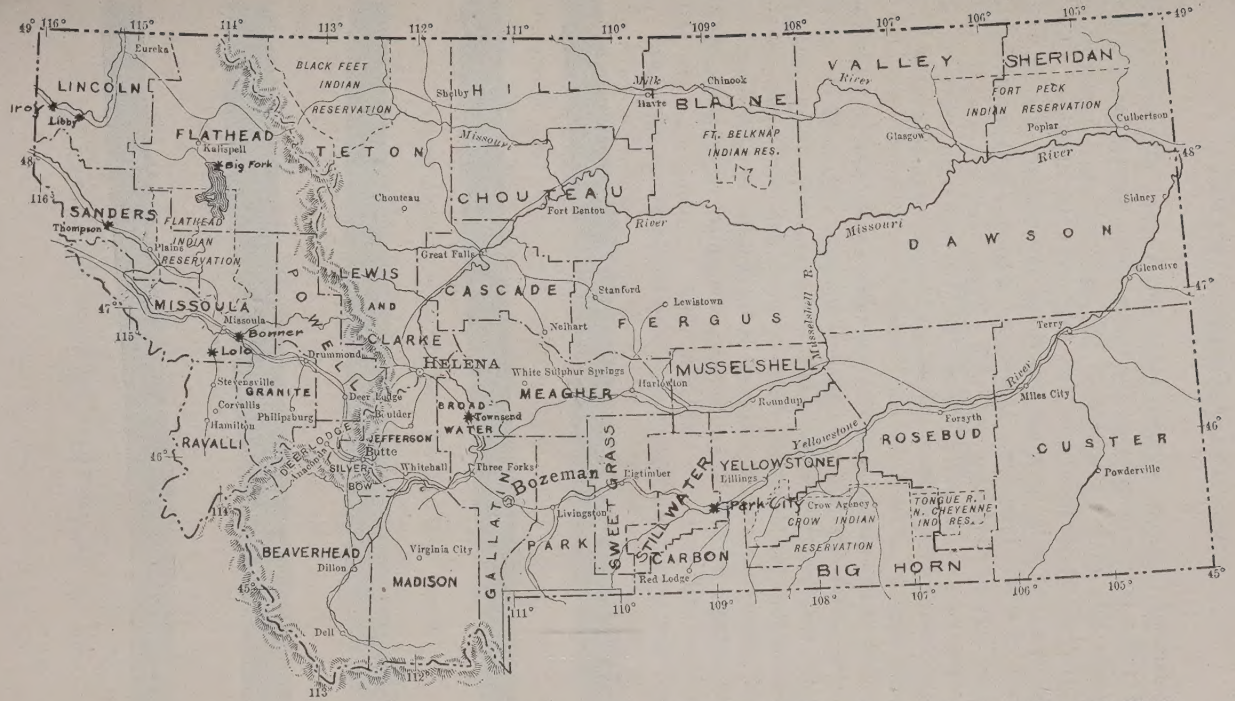
more previous to this. Before the close of the summer of 1908 there was a small amount of scab at Lo Lo; in 1909 it had spread to Stevensville, a distance of seventeen miles; in 1910 to Corvallis, fifteen miles farther south; and in 1911 the writer saw evidence of the disease throughout the Bitter Root Valley, which is seventy miles long and varies from one to several miles in width, Missoula being at the northern and lower end. It must not be understood that the infection was equally abundant in all parts of the valley as it was more prevalent in orchards on the bottom-land, while the orchards on some of the bench-lands were comparatively free; also the disease was much more prevalent in the northern than in the southern portion of the valley. In the fall of 1913 the scab had gained a strong foothold throughout the whole valley and the severity of the infection was more equalized than previously noted.

During 1911 the disease was reported from the vicinities of Libby, Troy, and Townsend, the last-named being the first place where the disease was reported east of the Continental Divide. In 1913 it was reported from the vicinity of Park City. A resume of the history of the apple scab in this State points clearly to the following places of separate infection, i. e., infection not due to wind, etc., carrying the spores directly from infected orchards,—Flathead, 1900; Thompson, 1904; Bonner about 1908; Troy and Libby, 1911; Townsend, 1911; and Park City, 1913.

The greatest distance observed between points of infection probably due directly to wind is about nine miles, when the scab spread from the vicinity of Missoula to Lo Lo. There are no orchards between these points, but the wind often blows in a southerly direction. There is a possibility that wind is responsible for infection over greater distances than this, but no conclusions can be drawn because sufficient data are not available as to the absence of intervening orchards.

### OCCURRENCE OF TWIG INFECTION

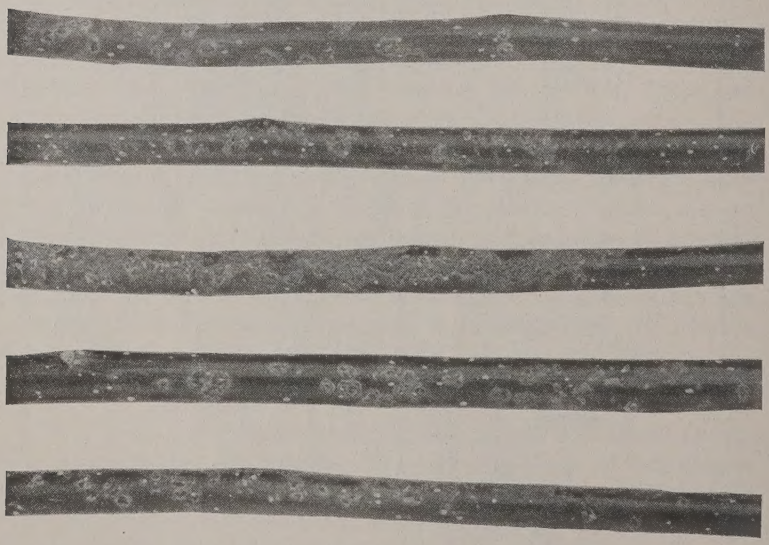
The occasional occurrence of twig infection is now a well known fact, although data as regards this particular phase of the disease are rather meager. Massee (305) records its presence on young shoots and claims that this is the principal source of spring infection and advocates the removal and destruction of infected twigs as




MAP OF MONTANA SHOWING POINTS OF FIRST INFECTION IN THE INTRODUCTION OF SCAB

a means of control. Sorauer (419) and Voges (465) mention the twigs as a means of carrying the fungus over winter, and the latter believes this to be a source of spring infection. Aderhold (6) records having observed only two cases of twig infection. Clinton (84) observed twig infection but found no evidence that it was a means of spring infection. Morse and Darrow (318) maintain that "under certain conditions and with certain varieties of apple trees, diseased twigs and water sprouts are an important factor in the propagation and spread of the disease at the beginning of the following year."

During the summers of the last three years climatic conditions were favorable for the development of apple scab, and the occurrence of twig infection was not at all infrequent. On susceptible varieties, notably the McIntosh, many of the young growing shoots and water-sprouts have been observed to be literally covered with scab for a distance of from a few inches to two feet. In appearance the individual scab spots are similar to those occurring upon the fruit, except that they are minute, being scarcely visible to the naked eye



SCAB ON TWIGS OF McINTOSH APPLE

but readily seen under a low magnification. During the last three years the writer has never failed to find more or less twig infection on McIntosh trees in a particular orchard where scab was abundant. Living cultures were procured from some of these spots during the month of March, but no data were secured as to what extent such twigs are a source of spring infection.

### INFECTION PERIODS

Apple scab is a cool-climate disease, and under ordinary weather conditions the period of greatest infection is from the time the leaf buds begin unfolding until two or three weeks after the petals drop. Wallace (478) concluded that the primary spring infection usually occurs about the time the ascospores mature, if weather conditions at that time are favorable. The ascospores mature about as the apple blossoms are ready to open. There seems little danger of serious infection earlier than this, whatever the weather conditions may be.

The primary infection period in this State corresponds to that observed by Wallace, but during the cool, damp seasons of 1911 and 1912 there occurred a late summer or secondary infection. This took place about the middle of August or first of September, and at harvest time many minute scab spots were visible on the fruit, which might have been prevented by a late spraying. In both seasons this secondary infection was traced to periods of cool, rainy weather.

### DOES APPLE SCAB DIFFER FROM PEAR SCAB?

Mycologists have held for some time that these two diseases were caused by two distinct species of the genus Venturia, viz, *Venturia inaequalis* (Cke.) Wint. and *Venturia pirina* Aderh. That their views were not universally accepted is seen by the following statements. Duggar (137) in reference to this question says, "However, it is of considerable practical importance to know that some recent work tends to show that these fungi are distinct species; hence, if this is true, pear scab cannot spread to the apple and cause apple scab or vice versa." He later (138) makes the following statement, "The fungi causing these diseases (apple and pear scab) are very closely related, although quite generally referred to two distinct species," thereby expressing an element of uncertainty.

Smith (410) says, "Whether the pear and apple scab fungus are identical has ever been an unsettled question and still remains so."

In support of the theory that the fungi are distinct species, Stevens (424) in describing them gives the host of *Venturia pirina* as the pear and of *Venturia inaequalis* as the apple and other pomaceous fruits except the pear. Wallace (477) in reference to the history of apple scab makes the statement, "Its introduction into Australia was attributed to a Seckel pear imported from America; this is doubtful, however, since the scab disease of the pear has since been shown to be entirely distinct from that of the apple."

The latter view is supported by observations of the writer, covering a period of several years when he has seen scab abundant on apple trees, and Flemish pear trees in the same orchard were not attacked; yet the Flemish pear is generally conceded to be very susceptible to scab. In older sections where the two diseases have been prevalent for years, this fact could not be observed.

## INJURY AND LOSS

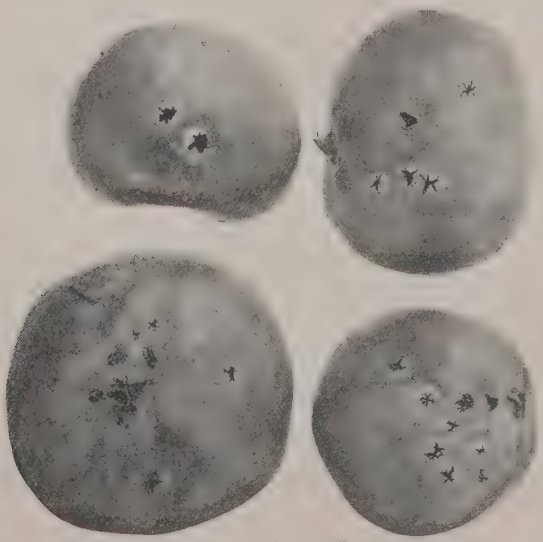
The injury and consequent loss to the apple crop due to the presence of scab is far greater than is generally appreciated for the following reasons.

1. The premature dropping of young apples due to the attacks of the fungus on flowers, petioles, and young fruits during or immediately following the blossoming period.
2. The apples which mature are of smaller size.
3. The loss due to the dropping of scabby apples before picking time.
4. The value of the harvested crop is reduced. Under the provisions of the Montana law and inspection regulations it is a violation of the law to place upon the market any scab-infected fruit from within or without the State or to ship it from the point of production.
5. The keeping quality of the fruit is greatly impaired. Craig and Van Hook (124) and Eustace (151 and 153) have proved beyond doubt that the presence of scab makes it possible for several serious soft-rot organisms to gain entrance and finally destroy the fruit.
6. The leaves are attacked and this results in impairing the vigor and health of the trees. In cases of slight infection the actual

damage done is hardly noticeable, but in severe infections such as have been observed by the writer on Delaware Red apple trees the damage is conspicuous. The trees were partially defoliated and the remaining leaves were distorted and curled, scarcely any growth was made throughout the season, and even the next year the trees showed the effect of the impaired vigor of the previous year.

7. The development of scab in storage. C. Brooks (60) reports great losses during the winter of 1909-10 by commission men in Boston from development of scab in storage, and he is of the opinion that scab developed from small colonies that were overlooked at the time of storage or else from spores that were on the apples at that time. From his experiments he concludes that a much greater benefit is derived from late sprayings for scab than is usually evident at the time of gathering.

Similar cases have occurred in this State which have caused losses of several hundred dollars to the owners. One in particular is worthy of notice. An owner of a large orchard sorted, culling out all scabby apples, and packed about two carloads of Mammoth



SCAB ON FRUIT

Black Twig about Christmas time, then stored them in a good warehouse for spring trade. When they were being shipped to market in March, they were condemned by the inspector on account of the winter development of scab. This necessitated sorting and repacking the whole shipment and from one-fourth to one-third of the apples were found to be scabby and were culled out. Whether the scab developed from minute spots overlooked in the first sorting or from spores that were on the apples could not be ascertained.

For these reasons it is a very difficult matter to place a money valuation on the total loss due to the disease. A conservative estimate of the loss due to scab in the Bitter Root Valley during 1911 and 1912 would be 15 per cent of the entire crop. This loss is due to the reduction in price or a total destruction of the fruit by the fungus.

## CONTROL

Under control there are two distinct methods of procedure.

1. Planting and care of the orchard.
2. Spraying or control by the application of chemicals in solution or suspension.

It is not the purpose of this paper to discuss the cultivation and general care of the orchard, but a few remarks upon varieties seem advisable. The proper distribution of varieties in an orchard is an important aid to proper and thorough spraying and this is especially true in regard to spraying for scab. If late-blooming and early-blooming varieties are badly mixed in rows, it is commercially impracticable to spray at the proper time, for example, when the flower buds show pink, as there will probably be a week's difference in time between the blooming of the different varieties and this would necessitate an extra spraying. For this reason it is desirable to set the trees in solid blocks, say four rows of one, then four rows of another, etc. For equally susceptible varieties, which blossom at about the same time, this would not be so important, but it is never advisable to mix susceptible and resistant varieties under any circumstances, as it complicates the problems which arise during spraying operations.

That there are great differences among the varieties of apple grown in the State with respect to their susceptibility to scab is well known to orchardists.

The selection and improvement of scab-resistant varieties may be one of the effective methods of dealing with this problem. To see that much progress has been made by this method with other crops one has only to mention a few familiar examples, such as wilt-resistant cowpeas, wilt-resistant watermelons, leaf-blight-resistant cantaloupes, rust-resistant wheat, etc.

No variey of apple is immune from scab under the most favorable conditions for the development of the fungus, and it is also recognized that varietal susceptibility may vary in different localities.

The opinion of several authors, that certain varieties may be resistant in one year and susceptible in another year under conditions which for average varieties are as favorable to the disease in one case as in the other, apparently does not apply in Montana.

The following tables give the resistance or susceptibility of the more common varieties grown in the western part of the State and is the conclusion of observations covering a period of five years, three of which were favorable for the development of the apple scab fungus.

TABLE SHOWING SUSCEPTIBILITY OF VARIETIES TO APPLE SCAB

| Class 1<br>Practically resistant | Class 2<br>Moderately resistant | Class 3<br>Moderately susceptible | Class 4<br>Susceptible |
|---|---|---|---|
| Hubbardston | Alexander | Akin | Black Twig (Mammoth) |
| Oldenburg (Duchess) | Baldwin | Arkansas Black | Blue Pearmain |
| Wagener | Gano | Ben Davis | Early Harvest |
| Wealthy | Gravenstein | Delicious | Fameuse (Snow) |
| York Imperial | Grimes (Golden) | Esopus (Spitzenburg) | Lawver (Delaware Red) |
| | Livland Raspberry | Jonathan | McIntosh |
| | Minkler | Maiden Blush | Peck |
| | Northwestern Greening | Monmouth | Red June |
| | Ortley | Northern Spy | Shiawassee |
| | Tetofsky | Pewaukee | White Pearmain |
| | Tompkins King | Red Astrachan | |
| | Yellow Transparent | Red Canada | |
| | | Rhode Island (Greening) | |
| | | Rome (Beauty) | |
| | | Walbridge | |
| | | Wolf River | |
| | | Yellow Bellflower | |

### SPRAYING

Concerning the value of spraying there is no longer any room for doubt. This is true as a general proposition, notwithstanding the occasional occurrence of a season like 1910 when the difference between sprayed and unsprayed orchards was so small as to be negligible when speaking in commercial terms. Unfavorable seasons for the development of fungi and insects have a tendency to support the theory of the uselessness of spraying, but abnormal seasons do not annihilate pests but only temporarily stop their development. The experience of many commercial growers, covering a period of years, is that thorough spraying is a good business proposition and one that pays quick returns on the investment.

The two fungicides which have been used to a considerable extent in this State are lime-sulphur and Bordeaux mixture. Of the two, lime-sulphur is the more important and is used generally over the State for controlling scab. The strength at which it is more commonly applied approximates that recommended by Scott (387),—that each 50 gallons of diluted spray should contain 4 pounds of sulphur in solution, which may be obtained by diluting one gallon of a concentrated solution testing 30° Baume with 30½ gallons of water. No cases of severe injury with lime-sulphur have been reported in the State, and when it has been carefully applied at the right time, using the above dilution, the scab has been controlled satisfactorily though not perfectly. Another advantage in using lime-sulphur is that the ordinary sprayings for scab will almost completely control the oyster-shell scale.

Bordeaux mixture was used to some extent in the earlier history of spraying for controlling scab in the State, but owing to its erratic behavior and the consequent loss by the russeting of the fruit and burning of the foliage it has been almost entirely replaced by lime-sulphur solution. However, at the present time a few are still using Bordeaux or a Bordeaux-Paris-green mixture with good results.

### WHEN TO SPRAY

Spraying is a preventive rather than a curative measure; therefore, the value of spraying at a correct time cannot be overestimated. For controlling scab on susceptible varieties—classes 3 and 4—the

following applications should be given, not varying more than three days before or after the specified time.

First. When the fruit buds have opened, but before the individual flower buds have expanded. In other words, when the flower buds first show a pink color.

A dormant spray applied four to six weeks before the buds are in the pink does not take the place of the "pink" spray, and if the dormant spray has been given, another application should be made at this time.

Second. When two-thirds to three-fourths of the petals of the blossoms have fallen.

Third. Ten days to two weeks after the second spraying, the shorter time being for damp, cool weather.

Fourth and Fifth. At intervals of two to three weeks after the last spraying. These are optional, depending upon weather conditions.

For fairly resistant varieties—classes 1 and 2—the "pink" and the "petal" sprayings should be given and perhaps one later spraying, depending upon weather conditions.

## COST OF SPRAYING

The cost of spraying depends so much upon conditions that it is rather hard to obtain any estimates that may be applicable to several localities.

Emerson, Howard and Westgate (146) estimate that the average cost per year for spraying an eighteen-year-old tree (four sprays) was twenty-four cents, and, furthermore, that the gain due to spraying one-half acre one year will under ordinary conditions buy a complete barrel spraying outfit, while the gain from spraying five acres will buy a complete power sprayer.

The following figures are for Montana conditions (Mont. Hort. Society, 14th Proceedings, p. 48, 1911):

Spraying with lime-sulphur, June, 1910.

Number of trees—1200; age—six years.

Equipment—New Way power sprayer, two 50-foot lines of hose, 10-foot spray rods, team, driver, and two spray men.

Material—63 gallons Rex lime-sulphur 1-20.

Time—seven hours (per tree, 21 seconds).

| | |
|---|---|
| Cost—63 gallons Rex | $15.12 |
| 3½ gallons gasoline | 0.95 |
| Labor, including board and supervision | 8.05 |
| Total | $24.12 |

Cost per tree—$0.02.

This spraying was done under favorable conditions, and the cost is perhaps somewhat below the average.

### GROWTH OF VENTURIA INAEQUALIS ON ARTIFICIAL MEDIA

Agar, apple*. Moderate growth; short dense mycelium; olive-green color; conidial spores on young culture, but absent when cultures were two months old, probably on account of germination.

Agar, beef (standard). Good growth; the mycelium short and very dense; olive-green color; conidia were formed when the culture was comparatively young, but disappeared as it became older.

Agar, litmus lactose. Slight growth, short, dense mycelium; olive-green color. There were spore-like bodies or swollen places in the mycelium with somewhat thickened walls, filled with granular protoplasm. The mycelium had a knotty appearance on this account.

Agar, potato. Very slight growth, long mycelium, olive-green color. At intervals in the mycelium were enlarged places, well filled with protoplasm. Not determined whether these are reproductive or resting bodies.

Agar, peptonized potato. Moderate growth, dense mycelium composed of long hyphae, hyaline to olive-green color, numerous conidia formed.

Agar, sugar-beet. Moderate growth, dense mycelium composed of medium-length threads, olive-green color, many conidia formed.

Bean tubes. Slight growth, dense mycelium composed of short hyphae, olive-green color. Many conidia, also many enlargements in mycelium, filled with protoplasm.

Bouillon, beef (standard). Slight growth in liquid, olive-green color. No formation of spores.

* Infusion of bark and wood with 2 per cent of agar added.

Corn tubes. Abundant growth, dense mycelium composed of short threads, olive-green color, many conidia formed.

Gelatin, beef (standard). Moderate growth; short, dense mycelium; olive-green color; no conidial spores formed. Gelatin not liquefied.

Hiss' plating medium. Growth moderate to abundant; short, dense mycelium; olive-green color. Numerous conidia present at all times.

Potato tubes. Moderate growth; very short, dense mycelium; olive-green color; numerous conidia formed.

Raulin's fluid. Moderate growth in liquid, olive-green color, no formation of spores.

Rice tubes. Moderate growth, dense mycelium composed of short threads, olive-green color, very few conidia.

Sugar-beet tubes. Slight growth, mycelium composed of long threads, olive-green color, many conidia formed.

Tapioca tubes. Moderate growth, dense mycelium composed of short threads, olive-green color, many conidia formed.

Wheat tubes. Moderate growth, dense mycelium composed of short branching hyphae, olive-green color, many conidia formed.

## BIBLIOGRAPHY

In preparing this bibliography the writer has endeavored to list only those references which add some knowledge to the subject. Mere compilations have been omitted. Nearly all the American literature has been reviewed and some of the foreign publications. In a few instances the exact title of foreign publications could not be obtained, and the reference is given with the translated title.

1. Aderhold, R. Die Perithecienform von Fusicladium dendriticum (Venturia chlorospora f. Mali) Ber Deutsch. Bot. Ges. 12: 338-342. 1894.
2. ———— Litterarische Berichtigung zu dem Aufsatze ueber die Perithecienform von Fusicladium dendriticum. Wallr. Ber. Deutsch. Bot. Ges. 13: 54-5. 1895.
3. ———— Die Fusicladien unserer Obstbaume. Landw. Jahrb. 25: 875-914. 1896.
4. ———— Revision der species Venturia chlorospora, inaequalis and ditricha autorum. Hedw. 36: 81. 1897.
5. ———— Arbeiten der botanischen abteilung der Versuchsstation des Kgl. pomologischen Instituts zu Proskan. Centbl. Bakt. 2: 521-522. 1899.

6. Aderhold, R. Die Fusicladien unserer Obstbaume. Landw. Jahrb. 29: 541-587. 1900.
7. ———— Die Fusicladien unserer Obstbaume. Centbl. Bakt. 2: 593-595. 1900.
8. ———— Arbeiten der botanischen abteilung der Versuchsstation des Kgl. pomologischen Instituts zu Proskan. Centbl. Bakt. 2: 661-662. 1901.
9. ———— Ein beitrag zur frage der empfanglichkeit der apfelsorten fur Fusicladium dendriticum (Wallr.) Fuckel and deren bezielungen zum wetter. Arb. K. Gesundheitsamte, Biol. Abt., 2: 560-566. 1902.
10. ———— Kann das Fusicladium von Crataegus und von Sorbusarten auf den apfelbaum ubergehn? Arb. K. Gesundheitsamte, Biol. Abt. 3: 436-439. 1903. (Berlin. 3 figs.)
11. Allen, W. J. Black spot of the apple and pear. Agr. Gaz. N. S. Wales. 22: 915. 1911.
12. Alwood, W. B. Apple scab. Bul. Va. Sta. 17: 60-61. Je. 1892.
13. ———— Diseases of plants, with remedial measures. Bul. Va. Sta. 24: 24. Ja. 1893.
14. Andre, Ed. Les Fusicladium et nos Vergers. Rev. Hort. 60: 246. 1888.
15. Anonymous. Apple scab. Grev. 20: 93: 27-29. S. 1891.
16. ———— Apple scab. Am. Agri. LI. (N. Y.) p. 139. 1892.
17. ———— Injurious insects and fungi. Jour. (British) Bd. Agr. I: 1. 1894.
18. ———— Does it pay to spray? Bul. Ont. Dept. Agr. Special. 8. Dec. 1897.
19. ———— First annual report of the Board of Trustees of the Mo. Fruit Exp. Station. Rept. Bd. Trustees Mo. Fruit Exp. Sta. 1900: 20.
20. ———— Some diseases of orchard fruits. Deut. Landw. Presse, 27: No. 57. 1900.
21. ———— Combating Fusicladium on fruit trees. Deut. Landw. Presse, 27: No. 91. 1900.
22. ———— The codling moth and apple scab. Gard. & Field. 28: No. 14. 1902.
23. ———— Combating diseases and insects of the orchard. An. Rpt. Mo. State Bd. Hort. 3: 348; 374-379. 1909.
24 ———— Fruit diseases. Bul. Oregon Sta. 1: ser. 1911. No. 48. 1911.
25. Arthur, J. C. Apple scab and leaf blight. An. Rept. N. Y. State Sta. 3: 370. 1885.
26. Atwood, G. G. Some items of information for orchardists and fruit growers relative to certain dangerous insects and diseases. Bul. N. Y. Dept. Agr. Bur. Hort. Insp. 1: 12. 1907.
27. Bailey, L. H. Report upon the condition of fruit growing in western New York. Bul. N. Y. Cornell Sta. 19: 46-50. Ag. 1890.
28. ———— Scab-proof apples. Gard. and For. 5: 442. 1892.
29. ———— The recent apple failures of western New York. Bul. N. Y. Cornell Sta. 84: 58-63, 66-68. 1895.

30. Bain, S. M. Notes on certain plant diseases in Tennessee. An. Rept. Tenn. Sta. 9: 17. 1896.
31. Ballou, F. H. Apple culture in Ohio. Bul. Ohio Sta. 217: 539, 548, My. 1910.
32. ———— The rejuvenation of orchards. Bul. Ohio Sta. 224: 117-150. D. 1910.
33. Beadle, D. W. The apple scab. Hort. Art .Jour. 5, pt. 10: 82 O. 1890. (Rochester, N. Y.)
34. Beach, S. A. Prevention of apple scab. Garden and Field, VI: 58.
35. ———— Latest results in spraying for apple scab. Trans. N. Y. Hort. Soc. 1892: 504-508. 1892, also Proc. West. N. Y. Hort. Soc. 1893: 69-72. 1893.
36. ———— Wood ashes and apple scab. Bul. N. Y. Geneva Sta. 140: 665-90. 1897.
37 Beach, S. A. & Bailey, L. H. Spraying in bloom. Bul. N. Y. Geneva Sta. 196: 399-460. 1900.
38. Beach, S. A., Lowe, V. H. & Stewart, F. O. Apple scab. Bul. N. Y. Geneva Sta. 170: 385-7. 1899.
39. Beach, S. A. & Little, E. E. Spraying calendar. Bul. Ia. Sta. 89: 4. 1907.
40. Beach, S. A. & Paddock, W. Apple scab. An. Rpt. N. Y. Geneva Sta. 14: 345-7. 1896.
41. Beal, W. J. Diseases of the apple. Proc. Michigan Hort. Soc. 1897.
42. Beattie, R. K. Lime-sulphur wash for apple scab. West. Fruit-Grower. 20: 1: 6-7. 1909.
43. Berkeley, M. J. Why do pears and apples crack? Gard. Chron. 1855: 724. 1855.
44. Bethune, C. J. S. Apple scab and commercial lime-sulphur. Rpt. Ont. Agri. Col. & Exp. Farm. 35: 34-35. 1910.
45. ———— Spraying experiments. An. Rpt. Ont. Agri. Col. & Exp. Farms. 36: 31. 1911.
46. Bizzozero, G. Fusicladium dendriticum var minor, Sacc. Fl. Ven. Crittog. 1: 510. 1885.
47. Blair, J. C. Spraying apple trees, with special reference to apple scab fungus. Bul. Ill. Sta. 54: 181-204. 1899.
48. ———— Orchard management. Bul. Ill. Sta. 59: 388-395. 1900. (Illustr.)
49. ———— Fruit and orchard investigations. Cir. Ill. Sta. 107: 1-58. 1907.
50. Blodgett, F. M. Experiments in the dusting and spraying of apples. Bul. N. Y. Cornell Sta. 340: 149-179. Ja. 1914.
51. Bonns, W. W. Orchard spraying experiments. Bul. Me. Sta. 189: 34-80. Ap. 1911.
52. ———— Orchard spraying experiments. Bul. Me. Sta. 198: Mr. 1912.
53. Bonorden, H. E. Fusicladium virescens. Handb. Allg. Myk. 80: 1851.
54. Bourcart, E. Insecticides, fungicides and weedkillers. 1913. (Translated from the French, revised and adapted to British standard and practice

by D. Grant Scott, Greenwood & Son, London.)
55. Bradley, C. E. Some recent work in Bordeaux mixture. Better Fruit. 3[no]: 31. Ap. 1909.
56. Brefeld, O. Venturia ditricha F. Piri. Unter. Gesammt. Mykol. heft. 10: 221. 1891.
57. Bretschneider, A. Apple scab. Wiener Landw. Ztg., 59: 980-981. 1909.
58. Brick, C. American fruit and its parasites. Station fur Pflanzenschutz zu Hamburg. I: 34. 1898-99.
59. Briosi & Cavara. Fusicladium dendriticum (Wallr.) Fckl. Fung. par. No. 140. 1892.
60. Brooks, C. Diseases of the apple. Rpt. N. H. Sta. 17-18: 267-269. 1907.
61. ———— Report of the department of botany. Rpt. N. H. Sta. 19-20: 371-372, 382-389. 1908.
62. ———— Some apple diseases. Bul. N. H. Sta. 144: 113. 1909.
63. ———— Report of the department of botany. Bul. N. H. Sta. 151: 21-22. 1910.
64. ———— Some apple diseases and their treatment. Bul. N. H. Sta. 157: 5-10. Ap. 1912.
65. ———— Fungicides in the apple orchard. Bul. N. H. Sta. 161: 3-15. Jl. 1912.
66. Brunk, J. L. Spraying experiments. An. Rpt. Md. Sta. 4: 383. 1891.
67. Budd, J. L. The apple trees and apple crop on the Iowa College Farm. Bul. Iowa Sta. 18: 517. Ag. 1892.
68. Burrill, T. J. Notes on parasitic fungi. Agr. Rev. 2: 4: 86-88. 1882.
69. ———— An orchard scourge. Trans. Miss. Vall. Hort. Soc. I: 202-7. 1883.
70. ———— The apple scab fungus. Trans. Ill. Hort. Soc. 34: 86-97. 1901.
71. Burrill, T. J. & McCluer, G. W. Experiments with fungicides on the apple, potato and grape. Bul. Ill. Sta. 15: 489-496. 1891.
72. Butz, G. C. Apples in Pennsylvania. Bul. Penn. Sta. 43: 13-16. 1898.
73. Card, F. W. Apple scab in Nebraska. Gard. & For. 8: 28. 1895.
74. Carruthers, W. Diseases of trees and plants. Jou. Roy. Agr. Soc. England. 63. 1902.
75. Chester, F. D. The scab of apple and pear. Bul. Del. Sta. 3: 6-7. 1888.
76. ———— Experiments on the treatment of peach rot and apple scab. Bul. Del. Sta. 29: 18-24. 1895.
77. ———— Experiments in the treatment of apple scab. Ann. Rpt. Del. Sta. 8: 51-59. 1896.
78. ———— Experiment in the treatment of apple scab. Bul. Del. Sta. 34: 14-19. Ja. 1897.
79. ———— Report on the treatment of apple scab. Ann. Rpt. Del. Sta. 10: 39-45. 1898.
80. ———— Report on the treatment of apple scab, 1898. Ann. Rpt. Del. Sta. 11: 27-30. 1899.

81. Chester, F. D. Apple scab. Ann. Rpt. Del. Sta. 12: 36-38. 1900.
82. Churchill, G. W. Some common fungous diseases and their treatment. Ann. Rpt. N. Y. Geneva Sta. 9: 310, 337-8. 1890.
83. Clark, J. W. Spraying experiments. Bul. Mo. Sta. 13: 6. Ja. 1891.
84. Clinton, G. P. Apple scab. Bul. Ill. Sta. 67: 109-156. 1901. (pl. 1-4.) (fig. 1-34.)
85. Clinton, C. P. Notes on parasitic fungi. Ann. Rpt. Conn. Exp. Sta. 27: 301. 1904.
86. ———— Report of the botanist of 1909-10. Conn. Sta. Rpt. 1909-10: 584-599, 716. 1911.
87. Clinton, C. P. & Britton, W. E. Test of summer sprays on apples, peaches, etc. Ann. Rpt. Conn. State Sta. 1911: 358-371. 1912.
88. Close, C. P. Apple scab. Bul. Utah Sta. 65: 67-8. 1900.
89. ———— Dust spraying in Delaware. Bul. Del. Sta. 69: 3-7. Mr. 1905.
90. ———— Dust and liquid spraying. Bul. Del. Sta. 72: 1-23. 1906.
91. ———— Third report on dust and liquid spraying. Bul. Del. Sta. 76. D. 1906.
92. Cobb, N. A. Fungous diseases of fruit trees. Bul. N. S. Wales Dept. Agri. 4. Fe. 1891. (Sydney.)
93. ———— Apple scab. Agr. Gaz. N. S. Wales 2: 216, 492. 1892.
94. ———— Apple scab "Tasmanian Black Spot." Agr. Gaz. N. S. Wales 3: 276-8. 1893.
95. Collier, P. Some of the most common fungi and insects, with preventives. Bul. N. Y. Geneva Sta. N. S. 35: 606-607. Ag. 1891.
96. Collier, P. Spraying apple orchards for scab. Bul. N. Y. Geneva Sta. 84: 19, 29-33. Ja. 1895.
97. Collinge, W. E. Plant diseases due to fungi. Rpt. Econ. Biol. 1: 1911.
98. Comes, O. Fusicladium dendriticum, Fck. Critt. Agr. 394. 1891.
99. Cooke, M. C. Sphaerella inaequalis, Cke. Seem. Jour. Bot. 4: 248-9. 1866.
100. ———— Sphaerella inaequalis, Cke. Handb. Brit. Fungi. 916. 1871.
101. ———— Spilocaea pomi, Fr. Grev. 2: 64. 1873.
102. ———— The hyphomycetous fungi of the United States. Bul. Buff. Soc. Nat. Sci. 3: 198. 1877.
103. ———— Apple scab. Grev. 20: 27-29. 1891.
104. ———— Pests of orchard and fruit garden. Jour. Roy. Hort. Soc. 28: 6-8. 1903. (London.)
105. ————Apple and pear scab. Jour. Roy. Hort. Soc. 29: 1-3. 1904. (London.)
106. Cooper, E. Fungi and fungicides. Rpt. Calif. Sta. Hort. Com. 1905: 4-5. 1905.
107. Corbett, L. C. Apple scab. Bul. W. Va. Sta. 66: 204-6. 1900.
108. ———— The value of spraying. Bul. W. Va. Sta. 70: 354-5. 1900.
109. Cordley, A. B. Apple scab. Ann. Rpt. Ore. Sta. 15: 51-52. 1903.
110. ———— Apple scab. Ann. Rpt. Ore. Sta. 16: 38-40. 1904.

111. Cordley, A. B. Lime-sulphur spray to prevent apple scab. Better Fruit. $3^3$: 26. Sept. 1908.
112. ———— The lime-sulphur spray as a preventive of apple scab. Ore. Agri. **17:** 178. 1908.
113. ———— The lime-sulphur spray as a preventive of apple scab. Rural New-Yorker. **67:** 202. 1908.
114. ———— Lime-sulphur spray preventive of apple scab. Better Fruit. $3^{10}$: 33. Ap. 1909.
115. Costantin, J. Fusicladium. Les Mucedinus Simples. 69-71. 1888.
116. Craig, John. Experiments with fungicides. Rpt. Can. Exp. Farms. **1890:** 95-100. 1891.
117. ———— Treatment of apple scab and of grape and gooseberry mildew. Bul. Can. Central Exp. Farm. 10: 15. Ap. 1891.
118. Craig, J. Apple scab. Rpt. Can. Exp. Farms. **1892:** 97, 106-7. 1893.
119. ———— Apple and pear blight. Rpt. Can. Exp. Farms. **1893:** 88-95. 1894.
120. ———— Spraying experiments. Rpt. Can. Exp. Farms. **1894:** 108-111, 113-121. 1895.
121. ———— Spraying experiments. Rpt. Can. Exp. Farms. **1895:** 117-120. 1896.
122. ———— Dust or powder sprays. Bul. N. Y. Cornell Sta. 216: 111-114. Feb. 1904.
123. Craig, John & Sharpe, T. A. Fungicides. Rpt. Can. Exp. Farms. **1891:** 144-147. 1892.
124. Craig, John & Van Hook, J. M. Pink rot, an attendant of apple scab. Bul. N. Y. Cornell Sta. 207. N. 1902.
125. Crandall, C. S. Spraying apples. Bul. Ill. Sta. 106: 216. F. 1906.
126 ———— Bordeaux mixture. Bul. Ill. Sta. 135: 200-296. 1909.
127. Crawford, F. S. Report on the Fusicladiums, the codling moth and certain other fungous and insect pests attacking apple and pear in South Australia. The apple and pear scab fungi. Part I: 7-31. 1886.
128. Cuboni, G. Sulla forma ibernante del Fusicladium dendriticum. Bul. Soc. Botn. Ital. 287-8. 1892.
129. Cummings, M. B. Apple orchard survey of Niagara county. Bul. N. Y. Cornell Sta. 262: 277-320. 1909.
130. Curtis, M. A. Spilocaea pomi, Fr. Curtis Cat. Plants, N. Car. 121. 1867.
131. Denny, F. E. Spraying in an off year. Bul. Nebr. Sta. Hort. Soc. No. 16.
132. Detmers, F. Apple scab. Bul. Ohio Sta. $\mathbf{IV}^3$: (Second Series) 187-192. D. 1891.
133. Dickens, A. & Headlee, T. J. Spraying the apple orchard. Bul. Kan. Sta. 174. Ja. 1911.
134. ———— Spraying apples. Cir. Kan. Sta. 15: 1-8. 1911.
135. Duby, S. H. Spraying to prevent apple and pear scab. Rural New Yorker. 55. 2411: 256. 1896.

136. Dudley, W. R. Report of cryptogamic botanist. Rpt. N. Y. Cornell Sta. 3: 32-33. 1890.
137. Duggar, B. M. Some important pear diseases. (Does pear scab differ from apple scab?) Bul. N. Y. Cornell Sta. 145: 617. F. 1898.
138. Duggar, B. M. Fungous diseases of plants. p. 264. 1909. (Ginn & Co., New York.)
139. Dunlap, H. M. Spraying experiments. Trans. Ill. Hort. Soc. 1898: 336-355.
140. Earle, F. S. Fruit and vegetables on the Gulf Coast. Bul. Miss. Sta. 37: 114. Mr. 1896.
141. ———— Orchard notes. Bul. Ala. Sta. 98: 266. N. 1898.
142. Ellis, J. B. Dothidea pomigena. Schw. N. A. Pyr. 605. 1892.
143. Emerson, R. A. Apple scab and cedar rust. Bul. Nebr. Sta. 88: My. 1903.
144. ———— Spraying demonstrations in apple orchards. Bul. Nebr. Sta. 98: 15-35. Ap. 1907.
145. Emerson, R. A. & Denny, F. E. Does it pay to spray Nebraska apple orchards? Bul. Nebr. Sta. 106. My. 1908.
146. Emerson, R. A., Howard, R. F. & Westgate, V. V. Spraying as an essential part of profitable apple orcharding. Bul. Nebr. Sta. 119. 1911.
147. Eriksson, J. Bidray till kaennedomen om vara odlade vaxters sjukdomar. Medd. frau Kongl. Landtt. Akad. Exp. 1: 61. 1885. (Abs. in Bot. Centr.)
148. ———— Der Schorf der Obstbaume. Bot. Centr. 26: 345-7. 1886.
149. ———— Om fruktraddsskop och fruktradsmogel samt medlem till dessa jukfomars bekamponde. K. Landt. Akad. Handl. och Tidskr. 42. 1. 1903.
150. ———— Die rote farbe der fruchtschake und die scharfkrankheit der obstsorten. Ztschr. Pflanzenkrank. bd. 21. hft. 3. 129-131. Ap. 1911. (Stuttg.)
151. Eustace, H. J. A destructive apple rot following scab. Bul. N. Y. Geneva Sta. 227. D. 1902.
152. ———— Two decays of stored apples. Bul. N. Y. Geneva Sta. 235. Jl. 1903.
153. ———— Hypcohnus sp. another apple rot following scab. Bul. N. Y. Geneva Sta. 255. Jl. 1903.
154. ———— Enlargement of apple scab spots under a covering of Bordeaux mixture. Bul. N. Y. Geneva Sta. 297: 47. 1908.
155. Evans, W. H. Apple scab. Handb. Exp. Sta. Work. 1893.
156. Ewert, R. Die uberwinterung von sommer konidien pathogenor ascomyceten und die widerstandsfahigkeit derselben gegen kalte. Ztschr. Pflanzenkrank. 20. No. 3. 1910.
157. Fairchild, D. G. Treatment of apple scab in Brockport. Bul. U. S. Dept. Agr. Div. Veg. Path. 3: 62. 1892.
158. ———— Bordeaux mixture as a fungicide. Bul. U. S. Dept. Agr. Div. Veg. Path. 6: 43-44. 1894.
159. Farrand, T. A. Report of South Haven Substation for 1904. Bul. Mich. Sta. Special 30. 1905.

160. Faurot, F. W. Report on fungous diseases on cultivated fruits. Bul. Mo. Fruit Sta. 6:4. 1903.
161. Faurot, F. W. Treatment of apple diseases. Bul. Mo. Fruit Sta. 15. 1906.
162. ———— Spraying versus dusting. Bul. Mo. Fruit Exp. Sta. 19: 18. D. 1908. (Mountain Grove.)
163. Fischer, F. Ueber die bekampfung des Fusicladium, Ztschr. Pflanzenkrank. 19: 7: 432-434. 1909. (Abs. in Rev. Patol. Veg. 4: 7: 1910.)
164. Flagg, C. O. The use of fungicides in the treatment of apple scab. Bul. R. I. Sta. 15: 21-2. 1892.
165. Frank, A. B. Fusicladium dendriticum, Fckl. Pflanzenkr. 587-9. 1880.
166. ———— Means of protection from the socalled scab of pomaceous fruits. Sept. Arb. K. Gesundheitsamte, Biol. Abt., 1900.
167. Freeman, E. M. Minnesota plant diseases. Rpt. of the Survey Botanical Series 5, St. Paul, Minn. Univ. of Minn. 351-353. Jl. 1905.
168. Fries, E. Spilocaea pomi, Fr. Nov. Fl. Suec. 5: 79. 1819.
169. ———— Spilocaea. Syst. Orb. Veg. 1: 198. 1825.
170. ———— Spilocaea pomi. Fr. Syst. Myc. 3: 504. 1829.
171. ———— Spilocaea epiphylla, Fr. Syst. Myc. 3: 504. 1829.
172. Fuckel, L. Fusicladium dendriticum (Wallr.) Symb. Myc. 357. 1869.
173. Funk, J. H. Spraying the sheet-anchor of success. Bul. Penn. Dept. Agri. 197: 85-94. 1910.
174. Galloway, B. T. Fusicladium dendriticum. Ann. Rpt. Mo. Hort. Soc. 29: 91. 297-299. 1887.
175. ———— Apple scab. Ann. Rpt. U. S. Dept. Agri. 1889: 405-12. 1889. (Cir. Veg. Path. 10. 1891.)
176. ———— Some diseases of plants. Bul. U. S. Dept. Agri. Div. of Botany. 8: Pt. II. 1889.
177. ———— Report of experiments made in 1889 in the treatment of the fungous diseases of plants. Bul. Dept. Agri. Sec. of Veg. Path. 11. 1890.
178. ———— Apple scab. Paper before Amer. Pomological Society. S. 1891.
179. ———— Treatment of apple, pear, peach, plum, cherry and quince diseases in the orchard. Ann. Rpt. U. S. Dept. Agri. 1891: 362-364. 1892.
180. ———— Report of experiments made in 1891 in the treatment of plant diseases. Bul. U. S. Dept. Agri. Div. of Veg. Path. 3: 31-6. 1892.
181. ———— Spraying fruits for insect pests and fungous diseases. Farmers' Bul. U. S. Dept. Agri. 7: 14. Mr. 1892.
182. ———— Apple scab. Jour. Myc. 7. 4: 373. 1894.
183. Galloway, B. T. & Taft, L. R. Apple scab. Bul. Mich. Sta. 59: Mr. 1890. (Reprint from Bul. No. 11, Sec. of Vegetable Pathology)
184. Galloway, B. T. & Southworth, E. A. Treatment of apple scab. Jour. Myc. 5: 210-214. 1889.
185. Garman, H. Apple scab. Ann. Rpt. Ky. Sta. 2: 46-9. 1890.
186. ———— Bordeaux mixture for apple pests. Bul. Ky. Sta. 44: 25-6. Ja. 1893.

187. Garman, H. Apple scab. Ann. Rpt. Ky. Sta. 6: 53. 1894.
188. ———— Some pests likely to be disseminated from nurseries. Bul. Ky. Sta. 80: 228-230. Mr. 1899.
189. ———— Spraying apple trees. Bul. Ky. Sta. 133: 12, 13, 66. Ja. 1908.
190. Goethe, R. Weitere beobachtungen uber den Apfel und Birnenrost Gartenflora 36: 293-299. 1887.
191. ———— Zur Bekampfung der Apfelrostes. Gartenflora 37: 263. 1888.
192. ———— Zur Bekampfung der Apfelrostes. Gartenflora 38: 241. 1889.
193. Goff, E. S. An experiment for the prevention of apple scab. Ann. Rpt. N. Y. Geneva Sta. 4: 231-2. 1886.
194. ———— Hyposulphite of soda as a preventive of scab on the apple and pear. Ann. Rpt. N. Y. Geneva Sta. 5: 117-8. 1887.
195. ———— Applications for the prevention of apple scab. Ann. Rpt. N. Y. Geneva Sta. 6: 99. 1888.
196. ———— Soda hyposulphite contrasted with potassium sulphide and calcium sulphide for the apple scab. Ann. Rpt. N. Y. Geneva Sta. 7: 154-7. 1889.
197. ———— Treatment for apple scab. Jour. of Myc. 5: 35-7. 1889.
198. ———— Treatment of apple scab. Jour. Myc. 6: 19-21. 1890.
199. ———— Report on the treatment of apple scab. Bul. U. S. Dept. Agri. Sec. Veg. Path. 11: 22-8. 1890.
200. ———— Prevention of apple scab. Bul. Wis. Sta. 23: 1-11. 1890.
201. ———— Prevention of apple scab. Fusicladium dendriticum, Fckl. The Prairie Farmer 62: 246. 1890.
202. ———— Experiment in the treatment of apple scab. Jour. Myc. 7: 17. 1891.
203. ———— Experiment in the treatment of apple scab. Ann. Rpt. Wis. Sta. 8: 160-1. 1892.
204. ———— Preventive treatment of some fungous diseases. Bul. Wis. Sta. 34: 34-7. Ja. 1893.
205. ———— Report of work in vegetable pathology. Ann. Rpt. Wis. Sta. 9: 264-270. 1893.
206. ———— Notes on the treatment of apple scab. Bul. Office of Exp. Sta. U. S. Dept. Agri. 16: 87-88. N. 1892.
207. ———— The apple scab and its prevention. Ann. Rpt. Wis. Sta. 10: 228. 1894.
208. Gossard, H. A. Spraying apples. Bul. O. Sta. 191: 103-125. 1908.
209. ———— Apple spraying in 1908. Cir. O. Sta. 95: 1-8. 1909.
210. ———— Commercial apple orcharding in Ohio. Cir. O. Sta. 112: 1-15. 1911.
211. Green, W. J. The spraying of orchards. Spraying to prevent apple scab. Bul. O. Sta. IV$^2$: 193-212. Dec. 1891.
212. ———— Spraying orchards and vineyards. Bul. O. Sta. 6$^4$: 8-11. F. 1893.

213. Green, W. J. Fruit notes. Ann. Rpt. O. State Hort. Soc. **31**: 11-2. 1898.
214. ———— Orchard spraying. Bul. O. Sta. 63: 97-102. 1895.
215. Green, W. J., Selby, A. D. & Gossard, H. A. Orchard spraying suggestions for 1911. Cir. O. Sta. 109. Fe. 1911.
216. Griffin, F. L. Experiment station results on apple scab. Better Fruit. 4[6]: 42. D. 1909.
217. Hall, F. H. The cause and control of Bordeaux injury. Better Fruit. 2[8]: 7-9. N. 1907.
218. Halsted, B. D. Decays of mature apples. Ann. Rpt. N. J. Sta. **14**: 369-371. 1894.
219. ———— Fusicladium dendriticum. Ann.Rpt. N. J. Sta. **15**: 324. 1895.
220. Hamilton, J. Black spot. Queensland Agr. Jour. **13**: 555. 1903.
221. Harvey, F. L. Apple scab or black spot. Ann. Rpt. Me. Sta. **1888**: 149-51. 1889.
222. ———— Apple scab. Ann. Rpt. Me. Sta. **1889**: 182-4. 1890.
223. Hatch, A. L. Experiments in treating apple scab. Jour. Myc. **7**: 26. 1891.
224. Heald, F. D. Report on the plant diseases prevalent in Nebraska during the season of 1905. Ann. Rpt. Nebr. Sta. **19**: 24. 1906.
225. Hedrick, U. P. Bordeaux injury. Bul. N. Y. Geneva Sta. 287: 1907.
226. Henderson, L. F. Apple scab. Bul. Ida. Sta. 15: 153. Jl. 1898.
227. ———— Apple scab in the Potlatch. Bul. Ida. Sta. 20: 79-95. 1899.
228. ———— Some experiments with fungous diseases in 1903. Ida. Sta. Bul. 39. Ja. 1904.
229. ———— Incomplete experiments for 1905. Ida. Sta. Rpt. **1905**: 14-15. 1906.
230. ———— Mixed sprays for apple scab and codling moth. Ida. Sta. Bul. 55. Ja. 1907.
231. ———— Spraying experiments in 1907. Ida. Sta. Bul. 61: 11-13. F. 1908.
232. Hewitt, J. L. How to control the scab and blotch of the apple. Cir. Ark. Sta. 7: Ap. 1911.
233. Hewitt, J. L. & Hayhurst, P. Diseases of apple trees and fruit caused by fungi and insects. Bul. Ark. Sta. 109: 419. 1911.
234. Hills, J. H. Summary studies of apple scab. Ann. Rpt. Vt. Sta. **20**: 407-409. 1907.
235. Hoffman, H. Cladosporium dendriticum. Index fungorum, p. 37. 1863.
236. Hoskins, T. H. Cladosporium dendriticum. Index Fungi. **37**: 1863.
237. Hunt, R. N. Spraying for apple scab. The Wash. Agriculturist. 5[4]: 9-10. (Pullman) Fe. 1912. (Ann. Proc. Mont. Sta. Hort. Soc. 15: 92. 1912.)
238. Huber, K. Fusicladium bekampfung durch kupperkalkbruhe oder karbolineum. Dent. Obstbau. Ztg. No. 23-24. 1908.
239. Jackson, H. S. Apple growing in the Pacific Northwest. 146-150. 1911. (Ed. Y. M. C. A. Portland, Ore.)

240. Jackson, H. S. Apple scab. Ore. Sta. Biennial Crop Pest and Hort. Rpt. 1911-1912: 238-41. 1912.
241. Jarvis, C. D. Apple growing in New England. Bul. Conn. Storrs Sta. 66: 256-261. 1911.
242. Johnston, T. H. Notes on some plant diseases. Agr. Gaz. N. S. Wales. 21: 1910.
243. Jones, F. R. Perithecia in cultures of Venturia inaequalis. Paper read at meeting of Amer. Phytopath. Soc. 1913-1914.
244. Jones, L. R. Black scab of apple. Ann. Rpt. Ver. Sta. 4: 142. 1891.
245. ———— Apple scab. Ann. Rpt. Ver. Sta. 5: 132-133. 1892.
246. ————. Plant diseases. Bul. Ver. Sta. 28: 30-34. Ap. 1892.
247. ———— Orchard diseases. Ann. Rpt. Ver. Sta. 6: 82-83. 1893.
248. ———— Spraying orchards and potato fields. Bul. Ver. Sta. 44: 83-93. 1894.
249. ———— Experiments in the prevention of apple and pear scab. Ann. Rpt. Vt. Sta. 8: 109-114. 1895.
250. Jones, L. R. & Morse, W. J. Orchard diseases and their remedies. Ann. Rpt. Vt. Sta. 15: 230-231. 1902.
251. ———— Occurrence of plant diseases in Vermont. Ann. Rpt. Vt. Sta. 16: 154. 1903. Ann. Rpt. Vt. Sta. 17: 385. 1904. Ann. Rpt. Vt. Sta. 18: 267-8. 1905. Ann. Rpt. Vt. Sta. 19: 231. 1906.
252. Jones, L. R. & Orton, W. A. Report of the botanists. Ann. Rpt. Vt. Sta. 11: 195-8. 1898. (Illustr.)
253. ———— Spraying for the prevention of apple scab. Ann. Rpt. Vt. Sta. 12: 156-159. 1899.
254. Keffer, C. A. Spraying apple trees. Bul. Mo. Sta. 27: 1-24. 1894.
255. Kern, F. D. Indiana plant diseases. Bul. Ind. Sta. 119: 427. Mr. 1907.
256. Kinney, L. F. The use of fungicides in the treatment of apple scab. Bul. R. I. Sta. 15: 21-22. 1892.
257. ———— Fungous parasites of the apple and pear. Ann. Rpt. R. I. Sta. 7: 185-7. 1895.
258. Kirk, T. W. Apple scab (Fusicladium dendriticum). 2nd issue Goot. Printer. Wellington, 1901. (Leaflet for gardeners 3 p. illust. 25 and ½ cm. New Zealand Dept. Agr. 25.)
259. Kirk, T. W. & Cockayne, A. H. Plant pathology. Ann. Rpt. New Zeal. Dept. Agri. 16: 1908.
260. Kock, G. Schorf, Monilia und weiss fleckig kelt obstsorten. Osterr, Ztschr. Landw. Versuchsw. 14: No. 3. 1911.
261. Lamson, H. H. Apple scab. Ann. Rpt. N. H. Sta. 1890-1891: 217-8: 238-239. 1892.
262. ———— Some fungous diseases of plants and their treatment. Bul. N. H. Sta. 19: 7-11. 1894.
263. ———— Spraying experiments in 1894. Bul. N. H. Sta. 27: 5-7. 1895.

264. Lamson, H. H. Notes on apple and potato diseases. Bul. N. H. Sta. 65: 107. My. 1899.
265. ———— Fungous diseases and spraying. Bul. N. H. Sta. 101: 59-60. Ap. 1903.
266. Lawrence, W. H. The apple scab in western Washington. Bul. Wash. Sta. 64: 1-24. 1904.
267. ———— Apple scab in eastern Washington. Bul. Wash. Sta. 75: 3-14. 1906.
268. ———— Some important plant diseases. Bul. Wash. Sta. 83: 25-28. 1907.
269. ———— Diseases of plants. Bul. Wash. Sta. Spec. Ser. 7: 95-102. 1911.
270. Lindau, G. Venturia chlorospora (Ces.) Karst. Die. Nat. Pflanzenf. 1: 431. 1897.
271. Link, H. F. Spilocaea pomi. Linn. Sp. Plant. 6²: 86. 1825.
272. Lloyd, J. W. Spraying for the codling moth. Bul. Ill. Sta. 114: 377-429. 1907.
273. Lochhead, W. Apple scab and peach-leaf curl. Rpt. Ontario Agr. Col. and Exptl. Farm. 1898.
274. ———— Some injurious insect and fungous diseases of the year 1902. Rpt. Ont. Agr. Col. and Exptl. Farm. 1903.
275. ———— Insects and fungous diseases. Ann. Rpt. Ont. Agr. Col. and Exptl. Farms. 30: 43. 1905.
276. ———— Three important fungous diseases of the orchard. Ann. Rpt. Quebec Soc. for the Protection of Plants from Insects and Fungous Diseases. 1: 53-55. 1909.
277. Lodemann, E. G. Prevalence of apple scab. Bul. N. Y. Cornell Sta. 48: 265-298. D. 1892.
278. ———— The profits of spraying apple orchards. Bul. N. Y. Cornell Sta. 60: 257-79. 1893.
279. ———— The spraying of orchards. Bul. N. Y. Cornell Sta. 86: 105-25. 1895.
280. ———— The spraying of plants. p. 88, 101, 243. 1897. (Macmillan Company, N. Y.)
281. Longyear, B. O. Fungous disease of fruits in Michigan. Spec. Bul. Mich. Sta. 25: Mr. 1904.
282. Lounsbury, C. P. The black spot, or scab, of the apple and pear. Agr. Jour. Cape Good Hope. 27. 2: 1905.
283. ———— The Fusicladium disease of the apple and pear. Agr. Jour. Cape Good Hope. 33: No. 1: 16-32. fg. 10. 1908.
284. Lovett, A. L. Spray calendar. Bul. Okla. Exp. Sta. 92: 1-16. 1911.
285. McAlpine, D. Spraying experiments in 1902 for black spot. Jour. Dept. Agr. Victoria. 1⁴ 1902.
286. ———— Experiments in the treatment of apple and pear scab during 1901-2. Jour. Dept. Agr. Victoria. 1⁵: 1902.

287. McAlpine, D. Experiments in the treatment of black spot of the apple and pear. Jour. Dept. Agr. Victoria. $1^6$: 1902.

288. ———— The fungus causing black spot of the apple and pear. Jour. Dept. Agr. Victoria. $1^7$: 1902.

289. ———— Black spot or scab of apples. Jour. Dept. Agr. Victoria. $2^4$: 354-360: $2^8$: 761-767. pls. 9. 1904.

290. ———— Black spot of apple. Bul. Dept. Agr. Victoria. 17: 32. 1904.

291. ———— Limewater Bordeaux for spraying. Jour. Dept. Agr. Victoria $8^2$: 1910.

292. ———— Results of spraying for black spot of apple and pear. Jour. Dept. Agr. Victoria (Australia). $9^3$: 184-190. 1911.

293. McCarthy, G. Plant diseases and how to combat them. Bul. N. C. Sta. 76: 15. Mr. 1891.

294. ———— The diseases affecting fruit trees and plants, with remedies for their repression. Bul. N. C. Sta. 92: 87-8. Ag. 1893.

295. McCormack, E. F. Apple scab. Ann. Rpt. Ind. Sta. Entomologist. 3: 145-147. 1910.

296. McCready, S. B. Spraying for apple scab. Ann. Rpt. Ont. Col. & Expt. Farm. 36. 1910.

297. Macoun, W. T. Black spot fungus or scab. Bul. Dept. Agr. Cent. Exp. Farm (Ottawa) Canada. 37: 67-8. 1901.

298. ———— Spraying. Rpt. Canadian Exp. Farms. 1901: 109. 1902.

299. ———— Spraying. Rept. Canadian Exp. Farms. 1902: 110-111. 1903.

300. Mally, C. W. Spraying for apple scab or black spot. Agr. Jour. Cape Good Hope. 35: 202-211. 1909.

301. Marchal, E. Les principaux maladies du pommier. Bul. Agr. (Brussels) 23: 41. 1907.

302. ———— Rapport sur les observations effectives par la service pathologique de l'Institute Agricolae de l'Etat en 1906. Bul. Agr. (Brussels) 23: 56-58. 1907.

303. Marlatt, C. L. & Orton, W. A. The control of the codling moth and apple scab. Farmers' Bul. U. S. Dept. Agr. 247. 1906.

304. Massee, G. A text book of plant diseases. 302-4, 435. 1899. (Macmillan Company, N. Y.)

305. ———— Diseases of cultivated plants and trees. 204. 1910. (Macmillan Company, N. Y.)

306. Massey, W. F. The culture of orchard and garden fruits. Bul. N. Car. Sta. 92: 87-88. 1893.

307. ———— The diseases and insects affecting apple trees in North Carolina with suggestions for their destruction. Bul. N. Car. State Bd. Agr. 21: 28-29. 1900.

308. Maynard, S. T. Fungicides and insecticides on the apple, pear, plum and grape. Bul. Mass. Hatch Sta. 11: 12-16. Ja. 1891.

309. Maynard, S. T. Experiments with fungicides and insecticides and with orchard fruits and grapes. Bul. Mass. Hatch Sta. 17: Ap. 1892.
310. Maynard, S. T. & Putnam, J. H. Report on fruit, insecticides, fungicides. Bul. Mass. Hatch Sta. 37: 3-4. 1896.
311. Merrill, G. E. Spraying the Nebraska apple orchard. Bul. Nebr. Sta. Hort. Soc. 22. My. 1909.
312. Mohr, K. Bericht uber die im Sommer 1899 angestellten versuche ebhufs bekampfung pflanzlicher schmarotzer auf reben und kernobst. Ztschr. Pflanzenkrank. 10: 270-274. 1900.
313. ———— Versuche uber die pilztotenden eigenschaften des sulfurins. Ztschr. Pflanzenkrank. 11: No. 2-3. 1901.
314. Morris, O. M. Apple scab. Bul. Okla. Sta. 64: 8. 1905.
315. ———— Apple scab. Ann. Rpt. Okla. Sta. 14: 56. 1905.
316. ———— Orchard spraying. Bul. Okla. Sta. 76: 27-28. 1908.
317. Morse, W. J. Notes on plant diseases. Bul. Me. Sta. 164: 9. 1909.
318. Morse, W. J. & Darrow, W. H. Is apple scab on young shoots a source of spring infection? Phytopathology. 3: 265. Oct. 1913.
319. Morse, W. J. & Lewis, C. E. Maine apple diseases. Bul. Me. Sta. 185: 352, 377, 392. D. 1910.
320. Morse, W. J. & Yeaton, G. A. Orchard spraying experiments in 1912. Bul. Me. Sta. 212. Mr. 1913.
321. Munson, W. M. Apple scab. Rpt. Me. Sta. 1891: 110-8. 1892.
322. ———— Spraying experiments. Rpt. Me. Sta. 1892: 92-8. 1893.
323. ———— Notes on spraying experiments. Rpt. Me. Sta. 1893[2]: 124-8. 1894.
324. ———— Spraying experiments. Bul. Me. Sta. 8: 2nd ser: Mr. 1894.
325. ———— Experiments in orchard culture. Bul. Me. Sta. 89: 16-18. 1903.
326. ———— Summary of experiments in practical horticulture. Bul. Me. Sta. 113: 26-27. 1905.
327. ———— Orchard notes. Bul. Me. Sta. 128: 69-71. 1906.
328. ———— Orchard notes. Bul. Me. Sta. 155: 143. 1907.
329. ———— Apple enemies and how to fight them. Bul. W. Va. Sta. 121: 353-366. 1909.
330. Niessl, G. V. Didymosphaeria inaequalis (Cke.) Nssl. Rab. Fung. eur. No. 2663. 1881.
331. ———— Bemerkung ueber Venturia inaequalis, Cke. und verwandte Formen. Hedw. Beibl. 37: 1-2. 1898.
332. Norton, J. B. S. & Norman, A. J. Controlling fungous diseases. Bul. Md. Sta. 143: 177-187, 200. 1910.
333. Orton, W. A. & Marlatt, C. L. Control of the codling moth and apple scab. Better Fruit. I[10]: 5. Ap. 1907.
334. Paddock, Wendell. Plant diseases in 1901. Bul. Colo. Sta. 69: 9. 1901.
335. Pammel, L. H. Apple scab and leaf blight. Prairie Farmer. 57: 746. 1885.
336. ———— Treatment of fungous diseases. Bul. Ia. Sta. 13: 48-49. My. 1891.

337. Parrott, P. J., Beach, S. A. & Woodworth, H. O. The lime-sulphur soda wash for orchard treatment. Bul. N. Y. Geneva Sta. 247: 78. Fe. 1904.

338. Parrott, P. J., Beach, S. A. & Serrine, F. A. Sulphur washes for orchard treatment. Bul. N. Y. Geneva Sta. 262. 1905.

339. Peck, C. H. Spilocaea pomi, Fr. N. Y. St. Mus. Nat. Hist. 23: 55. 1872.

340. ———— Fusicladium dendriticum, Wallr. N. Y. St. Mus. Nat. Hist. 34: 32-3. 1883.

341. Perrine, W. S. Unusual results in spraying in 1908. Fruit Grower. 20: 22. Ja. 1909. (St. Joseph, Mo.)

342. Persoon, C. H. Fumago mali. Myc. Eur. 1: 9. 1822.

343. Pickett, B. S. Spraying apple orchards for insects and fungi. Cir. Ill. Sta. 120: 1-36. 1908.

344. Piper, C. V. Common fungous diseases and methods of prevention. Wash. Sta. Bul. 8: 138. Je. 1893.

345. ———— Orchard enemies of the Pacific Northwest. Farmers' Bul. U. S. Dept. Agr. 153. 1902.

346. Planitz, A. von der. On the prevention of apple scab. Prak. Ratgeber Obst. u. Gartenbau. 30. 1899.

347. Powell, G. H. The apple scab. Gard. & For. 7: 297. 1894.

348. Powell, G. T. How to obtain more high grade fruit. Proc. West. N. Y. Hort. Soc. 37: 532. 1892.

349. Quaintance, A. L. & Scott, W. M. The more important insect and fungous enemies of the fruit and foliage of the apple. Farmers' Bul. U. S. Dept. Agr. 492: 23-26. Ap. 1912.

350. ———— Insect and fungous enemies of fruit and foliage of apple. Better Fruit $6^{12}$: 23-34. Je. 1912. (Reprint of Farmers' Bulletin U. S. Dept. Agr. 492: 23-25. Ap. 1912.)

351. Quinn, G. Seasonable notes on some orchard pests. Jour. Dept. Agr. So. Aust. $10^{1}$: 1906.

352. Reddick, D. Apple scab situation. Proc. West. N. Y. Hort. Soc. 58: 86-90. 1913.

353. ———— Factors influencing successful orchard spraying. Proc. N. Y. State Fruit Growers' Assoc. 12: 51-54. 1913.

354. Reddick, D. & Wallace, E. A laboratory method of determining the fungicidal value of a spray mixture or solution. Science, N. S. 31: 798. 1910.

355. Reed, H. S. & Cooley, J. S. Apple scab. Ann. Rpt. Va. Poly. Inst. 1909-10: 106. 1911.

356. Reed, H. S., Cooley, J. S. & Roger, J. T. Foliage diseases of the apple. Bul. Va. Sta. 195: 7. F. 1912.

357. Reed, H. S. & Crabill, C. H. Apple scab. Ann. Rpt. Va. Sta. Poly. Inst. 1911-12: 29-40. 1913.

358. Rolfs, P. H. Apple scab. Ann. Rpt. S. Car. Sta. 1900: 26. 1900.

359. Rolfs, F. M. Fruit tree diseases and fungicides. Bul. Mo. State Fruit Exp. Sta. (Mountain Grove) 16. Mr. 1907.

360. Roumeguire, C. Fusicladium dendriticum forma microsperma. Roum. Fungi, sil. exs. n. 5592. 1890.

361. Ruggles, A. G. & Stakman, E. C. Orchard and garden spraying. Bul. Minn. Sta. 121: 1-32. 1911.

362. Saccardo, P. A. Fusicladium dendriticum (Wallr.) Fckl. Var. minor. Sacc. Fung. Ital. f. 782. 1881.

363. ———— Fusicladium dendriticum (Wallr.) Fckl. Syll. Fung. 4: 345. 1886.

364. ———— Fusicladium dendriticum (Wallr.) Fckl. var. Soraureri (Thuem.) Sacc. Syll. Fung. 4: 346. 1886.

365. Salmon, E. S. Apple and pear scab. (Fusicladium dendriticum and F. pirinum.) Leaflet Gt. Brit. Agr. & Fish. bd. 131: 1-2. Mr. 1905.

366. ———— Apple scab or black spot. Jour. South-east. Agr. Col. Wye. 15: 215-220. Jl. 1906. (London.)

367. ———— Apple scab or black spot. (Conidial stage, Fusicladium dendriticum Fckl. ascigerous stage Venturia pomi (Fr.) Wint.) Gard. Chron. 40: No. 1020: 21-22. Jl. 1906. (London.)

368. ———— Apple scab or black spot. (Conidial stage, Fusicladium dendriticum Fckl. ascigerous stage Venturia pomi (Fr.) Wint.) Jour. Wye. Southeast Agr. Col. 16: 291-296. 1907. (London.)

369. ———— Apple scab or black spot. Jour. Bd. Agr. 15: 182-195. 1908. (London.)

370. ———— Apple scab or black spot and its treatment. Jour. Wye. Southeast Agri. Col. 17: 304-315. 1908. (London.)

371. ———— Black spot or apple scab. Jour. Southeast Agr. Col. Wye. 18: 267-270. 1909. (London.)

372. ———— A lime-sulphur wash for use on foliage. Jour. Bd. Agr. 17: 103-114, 184-189. 1910. (London.)

373. ———— On the use of lime-sulphur against apple scab. Jour. Southeast Agr. Col. Wye. 20: 408-418. 1911.

374. Sanderson, E. D., Headlee, T. J. & Brooks, C. Spraying the apple orchard. Bul. N. H. Sta. 131: 39, 41, 47-56. Ap. 1907.

376. Saunders, Wm. Apple scab. Canadian Horticulturist. 7[6]: 127. 1884.

376. Saunders, Wm. Apple scab. Canadian Horticulturist. 76: 127. 1884.

377. Scalia, G. Intorno ad una nuova forma di Fusicladium dendriticum. Bol. Accad. Gieenia, Catania, 70. 1901. (abs. in Bot. Centbl. 89. 1902.)

378. Schander, R. Zur karbolineumfrage. Deut. Landw. Presse. 36: 7: 1909.

379. Schoyen, W. M. Report on injurious insects and plant diseases in 1900. Beretning om Skadeinsekter og Plantesygdomme i 1900. Christiania, 1901.

380. ———— Report on injurious insects and plant diseases in 1902. Beretning om Skadeinsekter og Plantesygdomme i 1902. Christiania, 1903.

381. ———— Report on injurious insects and plant diseases for 1904. Beretning om Skadeinsekter og Plantesygdomme i 1904. Grondahl & Sons, 1905.

382. Schroeter, J. Fusicladium dendriticum (Wallr.) Kryp. Fl. Schl. 3[2]: 352. 1894.

383. Schweinitz, L. D. de Spilocaea fructigena aut Pomi, Lk. Syn. F. N. A. 297. 1834.

384. Scott, W. M. The control of apple bitter-rot. Bul. U. S. Dept. Agr. Bur. Pl. Ind. 93: 26. Mr. 1906.

385. ———— Lime-sulphur mixtures for the summer spraying of orchards. Cir. U. S. Dept. Agr. Bur. Pl. Ind. 27. Ap. 1909.

386. ———— Fighting apple scab in the Middle West. West. Fruit Grower. 20: 5-6. 1909.

387. ———— The substitution of lime-sulphur preparations for Bordeaux mixture in the treatment of apple diseases. Cir. U. S. Dept. Agr. Bur. Pl. Ind. 54. 1910.

388. ———— The substitution of lime-sulphur for Bordeaux mixture. Better Fruit. $6^{10}$: 21. Ap. 1912. (Cir. U. S. Dept. Agr. Bur. Pl. Ind. 54. Mr. 1910.)

389. ———— The use of lime-sulphur in the summer spraying of Virginia apple orchards. Bul. Va. Sta. 188. Mr. 1910.

390. ———— The use of dilute lime-sulphur for the control of apple diseases. Trans. Ill. Hort. Soc. 44: 138-145. 1911.

391. ———— Spraying the apple. Cir. Thomsen Chem. Co. 4: 4-6. Ap. 1912. (Baltimore, Md.)

392. Scott, W. M. & Quaintance, A. L. Spraying for apple diseases and the codling moth in the Ozarks. Farmers' Bul. U. S. Dept. Agr. 283. Ap. 1907.

393. Scott, W. M. & Rorer, J. B. Apple blotch. Bul. U. S. Dept. Agr. Bur. Pl. Ind. 144: 22. Mr. 1909.

394. Scribner, F. L. Fungous diseases of plants. Ann. Rpt. U. S. Dept. Agr. 1885: 81. 1886.

395. ———— Apple scab. Ann. Rpt. U. S. Dept. Agr. 1887: 341-7: pt. 2. 1888.

396. ———— The treatment of certain fungous diseases of plants. Spec. Bul. Tenn. Sta. 6: My. 1890.

397. ———— Fungous diseases of the grape and other plants. 1890.

398. ———— Apple scab and its treatment. Orch. & Gard. 12: 113. 1890.

399. ———— Apple scab. Orch. & Gard. $13^{6}$: 1891.

400. Secretan, L. Spilocaea pomi. Myc. Suisse: 594. 1833.

401. Selby, A. D. Some diseases of orchard and garden fruits. Bul. Ohio Sta. 79: 129-32. 1897.

402. ———— Apple scab. Bul. Ohio Sta. 111: 95-115. 1899. (Fig. 1-7.)

403. ———— Apple scab. Cir. Ohio Sta. 87: 4-8. D. 1908.

404. ———— Report on plant diseases in Ohio for 1909. Rpt. Ohio Sta. Hort. Soc. 43: 77-78. 1910.

405. ———— A brief handbook on the diseases of cultivated plants in Ohio. Bul. Ohio Sta. 214: 371. 1910.

406. ———— Disease susceptibility of apple varieties in Ohio. Cir. O. Sta. 133: 54. Ap. 1913.

407. Sherman, F. Spraying apples and pears. Cir. N. Car. Ag. Dept. Ent. 6: 1-7. 1904.

408. Smith, E. F. Field notes for 1892. Jour. of Myc. 7: 373-4. 1894.

409. Smith, J. B. & Halstead, B. D. Spraying for insect and fungous pests of the orchard and vineyard. Bul. N. J. Sta. 86: Ap. 1892.

410. Smith, R. E. Pear scab. Bul. Cal. Sta. 163: 4. D. 1904.

411. ———— Apple scab. Bul. Cal. Sta. 184: 246. Ja. 1907.

412. Smith, R. E. & Smith, Eliz. H. California plant diseases . Bul. Cal. Sta. 218: 1089. Jl. 1911.

413. Smith, W. G. Cracking of apples and pears caused by Cladosporium dendriticum. Gard. Chron. N. S. 24: 691.

414. Sorauer, P. Ueber die Entstehung der Rostflecken auf den Fruchten der Kernobstes, Vers. Deutsch. Naturf. u. Aerzte. 1874: 84-5. (Bot. Zeit. 33: 50-1. 1875.)

415. ———— Die Entstehung der Rostflecken, auf Aepfeln and Birnen. Monatsschrift Ver. Beford. Gart. Konigl. Preuss. Staatem. 18: 5-15. 1875.

416. ———— Fusicladium dendriticum. Die Obstbaumkrankheiten: 100-3. 1882.

417. ———— Die Rostflecke der Aepfel und Birnen. Handbuck Pflanzenkrankheiten: 392. 1886.

418. ———— Fusicladium dendriticum. Die Schaden Kulturpflanzen: 224. 1888.

419. ———— Handbuch der Pflanzenkrankheiten: 2: 249. 1908.

420. Sprague, C. J. Spilocaea fructigena, Schw. Proc. Soc. Nat. Hist. Bost. 5: 329. 1856.

421. Staes, G. Apple and pear scab. Tijschr. Plantenziekten, 4[5]: 1898.

422. Stone, A. E. Some suggestions on apple growing in Rhode Island. Rpt. R. I. State Bd. Hort. 25: 151-153. 1910.

423. Stevens, F. L. Fungous diseases of the apple. Bul. N. Car. Sta. 206: 87. 1910.

424. ———— The fungi which cause plant diseases. 253-255. 1913. (The Macmillan Co., N. Y.)

425. Stevens, F. L. & Hall, J. G. Diseases of economic plants. 74-78. 1910. (The Macmillan Co., N. Y.)

426. Stevens, F. L. & Sherman, F. Jr. Insect and fungous enemies of the apple, pear, and quince with methods of treatment. Bul. N. Car. Sta. 183: 64-66. 1903.

427. Stewart, F. C. Recent investigations on plant diseases. Proc. West. N. Y. Hort. Soc. 54: 77-81. 1909.

428. ———— Notes on New York plant diseases. Bul. N. Y. Geneva Sta. 328: 315. 1910.

429. Stewart, F. C. & Blodgett, F. H. A fruit-disease survey of the Hudson Valley in 1899. Bul. N. Y. Geneva Sta. 167: 283. 1899.

430. Stewart, F. C., Rolfs, F. M. & Hall, F. H. A fruit disease survey of western New York in 1900. Bul. N. Y. Geneva Sta. 191: 171. 1901.

431. Stewart, J. P. Concentrated lime-sulphur, its properties, preparation and use. Ann. Rpt. Penn. Sta. 1908-1909. Pt. 2. 259-296.

432. ———— The apple in Pennsylvania, varieties, planting and general care. Bul. Penn. Sta. 106: 11-13. 1910.

433. Stinson, J. T. Grapes and apples. Bul. Ark. Sta. 21: 57-58. D. 1892.

434. ———— Apple scab and bitter rot. Bul. Ark. Sta. 26: 23-33, 38-44. 1894.

435. ———— Spraying fruits, strawberries, grapes. Bul. Ark. Sta. 39: 20-1. Ja. 1896.

436. ———— Apple scab. Rpt. Mo. Fruit Sta. 1900: 15-17. 1900.

437. Stone, G. E. Potato and apple scab. Leaflet. Mass. State Bd. Agr. 7. 1907.

438. Streing, W. M. Apple scab. Nomenclator fungorum. 187, 280, 308.

439. Sturgis, W. C. Common fungous diseases and their treatment. Bul. Conn. State Sta. 111: 3-4. Mr. 1892.

440. ———— Common fungous diseases and their treatment. Bul. Conn. State Sta. 115: 3-4. Mr. 1893.

441. ———— Spraying for the scab of apple and pear. Rpt. Conn. State Sta. 1893: 72-73. 1894.

442. Fusicladium dendriticum (Wallr. Fckl.) Rpt. Conn. Exp. Sta. 1900: 258. 1901.

443. Summey, E. E. Shall we protect our apple crop? Cult. & Country Gentleman 61 yr. No. 1998 (Albany, N. Y.). 396-397. My. 1891.

444. Swingle, D. B. Apple scab. Proc. Mont. Hort. Soc. 10: 39. 1907.

445. ———— Proc. Mont. Hort. Soc. 11: 40-42. 1908.

446. ———— Proc. Mont. Hort. Soc. 12: 72-74. 1909.

447. Taft, L. R. Report on experiments with remedies for the apple scab. Bul. U. S. Dept. Agri. Div. Veg. Path. 11: 30-38. 1890.

448. ———— Reports on experiments made in 1889 in the treatment of apple scab in Michigan. Bul. Mich. Sta. 59: 30-42. 1890.

449. ———— Insecticides and fungicides. Bul. Mich. Sta. No. 83: 12-14. 1892.

450. ———— Orchard spraying. Bul. Mich. Sta. Special 37: 25-26. 1907.

451. Taft, L. R. & Davis, G. C. Apple scab. Bul. Mich. Sta. 121: 19-21. 1895.

452. Taft, L. R. & Smith, C. D. Spraying calender. Spec. Mich. Bul. Sta. 36: 266-274. 1907.

453. ———— Annual report of the South Haven substation for 1908. Spec. Bul. Mich. Sta. 48: 16-24. 1909.

454. Temple, C. E. Diseases of the apple. Ann. Rpt. Nebr. Hort. Soc. 39: 251. 1908.

455. Tetzner. Die schwefelkalkbruhe und ihr einfluss auf die kupfernen spritzen. Dent. Obstbaume Ztg. 14: 179-180.

456. Thuemen, F. V. Napicladium, eine neue Hyphomyceten Gattung. Hedw. 14: 3-4. 1875.

457. ———— Napicladium Sorauеri, Theum. Myc. Uni. 91. 1875.

458. ———— Ueber einige besonders beachtenswerte durch parasitische

Pilze hervorgerufene Krankheiten der Apfelbaumblatten. Zeit. Pflanzk. 1: 167. 1891.

459. Tillinghast, J. A. & Adams, G. E. Apple scab. Bul. R. I. Sta. 52: 20-1. 1899.

460. Trelease, W. The apple scab and leaf blight. Ann. Rpt. Wis. Sta. 1: 45-46. 1884.

461. ———— Fusicladium dendriticum (Wallr.) Prel. List. Par. Fungi. Wis. 15: 1884.

462. Von Tuberuf, K. F. & Smith, W. G. Diseases of plants induced by cryptogamic parasites, 218-220. 1897. (Longmans, Green & Co., N. Y.)

463. Underwood, J. M. & Earle, F. S. Treatment of some fungous diseases. Bul. Ala. Sta. 69: 269. F. 1896.

464. Voges, E. Ueber die scharfkrankheit der obstbaume. Dent. landw. pr. J. 34: nr. 33: 276-277, Ap. 24; nr. 34: 284-285, Ap. 27; nr. 35: 290-291. My. 1. Berlin, 1907.

465. ———— Die bekampfung des Fusicladium. Ztschr. Pflanzenkrank. 20: 385-393. 1910. (rev. in Gard. Chron. 3. ser., 48. No. 1250. 1910.)

466. Volck, W. H. Apple and pear scab. Better Fruit 7[5]: 61-63. Feb. 1913.

467. Waite, M. B. Fungous diseases of the apple and pear. Proc. Mich. Hort. Soc. 1897.

468. ———— Fungicides for preventing fruit diseases. Better Fruit. 1[10]: 12, 15. Ap. 1907.

469. ———— Experiments on the apple with some new and little known fungicides. Cir. U. S. Dept. Agr. Bur. Pl. Ind. 58: 1-19. 1910.

470. Walker, E. Suggestions upon the care of apple orchards. Bul. Ark. Sta. 91: 116, 201. 1906.

471. ———— Notes on spraying and suggestions for combating crop pests. Bul. Ark. Sta. 95: 50, 52, 58. 1907.

472. ———— Apple scab. Rpt. Niagara Spray Co. Fellowship, 2: 1909.

473. ———— The value of lime-sulphur solutions as fungicides. Proc. Amer. Pomol. Soc. 1909: 112-113. 1909.

474. ———— Spray injury induced by lime-sulphur preparations. Bul. N. Y. Cornell Sta. 288: 105-135. D. 1910.

475. ———— Venturia inaequalis, ascospore dissemination and infection. Science, N. S. 31: 753-754. 1910.

476. ———— Lime-sulphur as a summer spray. Bul. N. Y. Cornell Sta. 289: 141-162. Ja. 1911.

477. ———— Some recent experiments with lime-sulphur spray. Proc. Amer. Pomol. Soc. 1911.

478. ———— Apple scab infection as correlated with maturity of ascospores, weather conditions and development of fruit buds. Phytopathology. 2: 94. Ap. 1912.

479. ———— Scab disease of apples. Bul. N. Y. Cornell Sta. 335: 545-623. S. 1913.

480. Wallace, E., Blodgett, F. M. & Hesler, L. R. Studies on the fungicidal value of lime-sulphur preparations. Bul. N. Y. Cornell Sta. 290: 167-207. Ja. 1911.
481. Walbroth, F. G. Cladosporium dendriticum. Fl. Crypt. Germ. $1^2$: 169. 1833.
482. Warren, G. F. An apple orchard survey of Wayne Co., N. Y. Bul. N. Y. Cornell Sta. 226: 335-339. Mr. 1905.
483. ———— An orchard survey of Orleans County, New York. Bul. N. Y. Cornell Sta. 229: 475-487. My. 1905.
484. ———— Spraying. Bul. New Jer. Sta. 194: 12-15. 1906.
485. ———— Apple scab. Elements of Agriculture p. 253. 1909.
486. Warren, G. F. & Voorhees, J. A. Report of the horticulturist. Rpt. N. J. Sta. 27: 225. 1907.
487. Washburn, F. L. A combined fungicide and insecticide. Bul. Ore. Sta. 10: 11-16. Ap. 1891.
488. Watkins, O. S. A summary of various spraying experiments. Kinmundy, Ill. 1911. (Read before 44 An. Conv. of Ill. Sta. Hort. Soc. at Urbana, Ill. Feb. 1911.)
489. ———— Tests of lime-sulphur, Bordeaux mixture and other sprays. Cir. Ill. Sta. 159. Mr. 1912.
490. Weed, C. M. Notes on experiments with remedies for certain plant diseases. Bul. O. Sta. $2^7$: (Second Series) 1889.
491. ———— A season's work among the enemies of the horticulturist. Jour. Columbus Hort. Soc. $4^4$: D. 1889.
492. ———— Apple scab. Bul. O. Sta. 14: 188. 1890.
493. Weiss, J. G. Combating apple and pear scab. Vrtljschr. Bayer. Landw. Rath. $4^4$: 1899.
494. ———— The scab disease of apples, pears, etc., and its treatment. Prakt. Bl. Pflanzenschutz, 1900. No. 2.
495. Whetzel, H. H. The summer use of concentrated lime-sulphur. Proc. N. Y. Fruit Growers Association. 9: 1910.
496. Whetzel, H. H. & Stewart, F. C. The control of plant diseases. Bul. N. Y. Cornell Sta. 252: 190. 1908.
497. Whitehead, Chas. Methods of preventing and checking the attacks of insects and fungi. Jour. Royal Agri. Soc. 3rd Series. 2: 218, 222. 1891. (England.)
498. Whitten, J. C. Spraying orchards and vineyards. Bul. Mo. Sta. 31: 3, 6-7, 11-16. 1895.
499. Wight, R. A. Apple scab. Jour. Mycology. 5: 200. 1889.
500. Wilcox, E. M. Diseases of the apple, cherry, peach, pear and plum; with methods of treatment. Bul. Ala. Sta. 132: 97-102. Ap. 1905.
501. Williams, T. A. Common fungous diseases. Bul. S. D. Sta. 35: 79. 1893.
502. Winter, G. Ueber Napicladium Soraueri Thuem. Hedw. 14: 35-6. 1875.
503. ———— Venturia inaequalis, Wint. Thuem. Myc. uni. no. 1544. 1880.
504. Woodworth, C. W. Plant diseases. Rpt. Cal. Sta. 1894-1895: 239. 1896.
505. Wolverton, L. Treatment of apple scab. Canada Horticulturist. p. 165. Je. 1890.